Materials Development for Enhanced X-ray Detection of Dynamic Material Events Under Fast Loading Rates

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The official link for this solicitation is:
http://www.acq.osd.mil/osbp/sbir/solicitations/sbir20152/index.shtml

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Description:

The Defense Threat Reduction Agency’s Basic Research Program, Thrust Area 4 – Science to Defeat WMD (weapons of mass destruction), has been supporting research of hard and deeply buried targets including penetration of concretes and geological materials. With new experimental facilities that now couple high intensity and high flux x-ray capabilities with impact drivers (e.g. lasers, gas guns, etc.), an exciting opportunity exists for directly probing material deformation mechanisms under extreme loading conditions. Limitations in detection capabilities still present a significant hurdle to providing a complete mapping of the temporal evolution of complex materials under dynamic loading. New materials or methods that enhance x-ray diffraction and/or x-ray imaging measurements are desired, including both direct and indirect detection methods. Indirect detection uses phosphors or scintillators to convert x-rays to visible photons; whereas, direct detection schemes directly convert an x-ray photon to an electrical signal for readout. Certain detection schemes are currently more attractive to different experimental conditions and regimes of interest. PHASE I: Any new or improved materials must provide good sensitivity for photon energies greater than 20 keV. Proposed materials for enhanced indirect detection must possess fast decay times below 25 ns, spatial resolution < 5 µm and demonstrate photon collection efficiency >90%. In addition to being sensitive beyond 20 keV, materials for improved direct detection must be capable of achieving temporal resolution better than 150 ns (much faster temporal resolution capabilities

would be desired). Submitters are expected to produce materials that satisfy conditions for direct or indirect detection, not both. Experimental results must demonstrate that the materials of interest can reach or exceed these specifications. PHASE II: Based upon the Phase I performance results of these materials, DTRA will decide based upon costs/risks if Phase II work is to be initiated. Phase II work will focus on incorporating the improved material or technology into a detector capable of high frame rates (>10 MHz) and many frame data collection/storage (20-500 frames). Any detector will be submitted for further testing under high rate experimental conditions. Development of a commercialization strategy should also be achieved in Phase II. PHASE III: In addition to providing enhanced detection capabilities for directly probing complex materials under high rate deformation, new developments in time domain x-ray detection technology could be beneficial for investigating complex biological processes.